# PROJECT REPORT

# ON

# INVESTIGATION AND PROXIMATE ANALYSIS OF CARBON BLACK FROM WASTE TYRE

**In the partial Fulfillment of Bachelors of Technology in Mechanical Engineering**

Submitted

By

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## CERTIFICATE

This is to certify that the thesis entitled, **"Investigation and Proximate Analysis of Carbon Black from Waste Tyre "** submitted by **JYOTI RANJAN BEHERA** in partial fulfillment of the requirement for the award of Bachelor of Technology degree in Mechanical Engineering at National Institute of Technology, Rourkela is an authentic work carried out by him under my supervision and guidance.

To the best of my knowledge, the matter embodied in the thesis has not been submitted to any other University/Institute for the award of any Degree or Diploma.

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# ABSTRACT

The disposal of waste tire is increasing day by day at exponential rate. This waste tyre covers a huge amount of valuable land area and can also create a threat of fire accident. The world produces 1.5 billion scrap tires per year are produced and a major portion of which come from India and China (41%). A better solution from an environmental and economic standpoint is to thermally reprocess the tires into valuable products such as activated carbon, other solid carbon forms (carbon black, graphite, and carbon fibers), and liquid fuels to use it more effectively. One of the thermal processes is pyrolysis that waste tyres can be converted into gas, oil and solid product. For instance, solid product can be used as carbon black with some quality improvements especially removal of ash and sulphur. Due to the presence of high ash content limits its application in different products. The pyrolytic carbon black (CB) obtained was contaminated by various additives of the original tyre. Contaminants were also produced by chemical reactions occurring in the pyrolysis reactor. The carbon black obtained from pyrolysis of waste tyre contains some unnecessary metal content, so we need to separate the metal content so that we take maximum advantage of activated carbon.

# CONTENT

# 1. INTRODUCTION

The disposal of waste tire is increasing day by day at exponential rate. This waste tyre covers a huge amount of valuable land area and can also create a threat of fire accident. The world produces 1.5 billion scrap tires per year are produced and a major portion of which come from India and China (41%). These waste tires are not evaluated properly. Only in the EU, USA and Japan about 6 million tones per year of scrap tires are produced. The huge quantity of waste tire produced in the world will increase in the future as the associated automobile industries grow. The disposal of scrap tires becomes a concern environmental problem. The deposition of used waste tires leads to environmental pollution. A huge amount of the scrap tires is simply dumped in places where it represents hazards such as diseases and accidental fires. A rubber is not biologically degradable, and thus creates problems with their disposal. These waste tires can be minimized by recycling with material or energy recovery. During processing and molding rubber materials are cross linked, and hence they cannot be simply softened and remolded by heating. For several years landfill, was the main, practical means for dealing with the problem of waste tyres. Open dumping of waste tires may result in accidental fires along with high pollution emissions. In the EU countries in 1990 the percentage of tires discarded in landfills was 62% of all produced waste tires in 2000 were about 35% and in 2006 (as it results from the EU legislation) this percentage will decrease to 0%. Some countries including the Slovak Republic have already banned the use of discarded tires for landfilling [1]. A low percentage of waste tires are recycled and reused for rubber products. Because of their high calorific value, waste tires are used as fuel in rotary cement kilns. This process can be acceptable from an environmental point of view only in the case of controlled combustion due to the toxic emissions produced during the tire combustion processes.

To overcome such problems we need to recycle and reuse these waste tires. These waste tires can be converted into useful products by using pyrolysis method. Carbon black is the main product obtained from pyrolysis of waste tires. Fig. 1 show the availability of carbon black in the all over world.

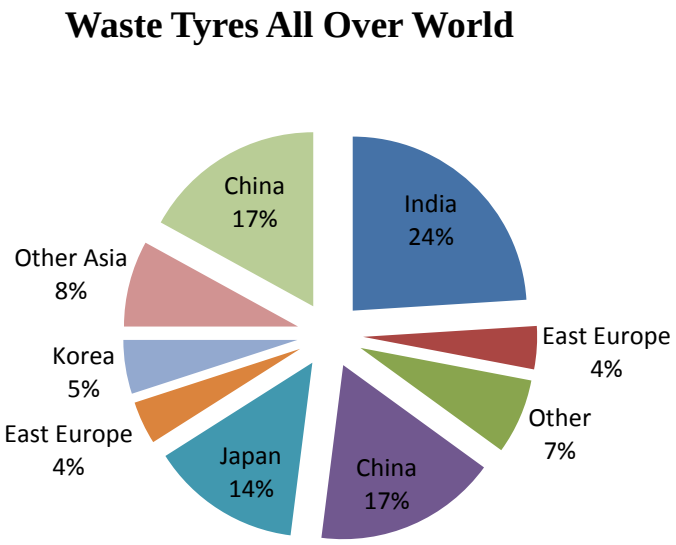


**Fig.1. Waste Tyre [2]**

Other byproducts are also obtained from pyrolysis of waste tire namely-pyro oil, pyro gas, steel wire. Out of which steel wires can be used in steel industry, pyro oil and pyro gas can be used as secondary fuel. Carbon black solid powder product of waste tire can be converted to activated carbon and can be useful because of its high calorific value.

## 2. LITERATURE SURVEY

The disposal of used tyres generated each year in the U.S. by landfill is increasingly becoming an unacceptable solution. A better solution from an environmental and economic standpoint is to thermally reprocess the tires into valuable products such as activated carbon, other solid carbon forms (carbon black, graphite, and carbon fibers), and liquid fuels. In this study, a high surface area activated carbon (> 800 $m^2$/g solid product) was produced in relatively high yields from pyrolysis of tires up to 900°C, followed by activation in CO, at the same temperature [4]. According to Uladzimir Kalitko Waste tires pyrolysis is well known method for their thermal recycling by heating at near 500°C with purpose of liquid oil and carbon black by-production as near 50% and 35% yield correspondingly, including about 10% combustible off-gas residual after oil condensing and 5% wire steel cord in rest (all relatively to tire mass) [3]. In connection

with possibility for steam self-producing along with tire pyrolysis recycling, it is a reason to analyze numerically and economically what is more effective way for steam use: power generation by turbine machine or carbon black production could be more as min 10% of tire rate additionally by inner heating with steam feeding into reactor as it is considered above in 6.1 according to Ware Pundlik, Shukla Vikaskumar, Kushvah Avadhesh, Desai K. R. [2]

Scrap tyres do not decompose easily in the nature and cause too many environmental problems. The carbon black obtained from pyrolysis of scrap tyres at a temperature of 500°C contains 11-12 % ash. Due to the presence of high ash content limits its application in different products. The pyrolytic carbon black obtained (CB) was contaminated by various additives of the original tire. Contaminants were also produced by chemical reactions occurring in the pyrolysis reactor. A characterization and demineralization of the recovered carbon black was performed and a possible reduction of the ash content by H2SO4, HCl, HNO3 and NaOH treatment was investigated. To enhance the commercial value of this CB so as to increase its potential usage, it is necessary to treat it. Common and low price reactants were chosen. Using HCl instead of sulfuric acid for the demineralization of the pyrolytic carbon black proved to be equivalent in terms of ash reduction.

In reprocessing waste tire to useful products many works are done till date. A. Chaala, H. Darmstadt, C. Roy*[5] have found that the carbon black material used as reinforcing filler in tires was recovered by vacuum pyrolysis at a temperature of 500°C and a total pressure of 20 kPa. The pyrolytic carbon black obtained (CBp) was contamined by various additives of the original tire. Contaminants were also produced by chemical reactions occurring in the pyrolysis reactor. The contamination is reflected by the high content of ash and gritty materials (coke) present in the CBp. A characterization of the recovered carbon black was performed and a possible reduction of the ash content by sulfuric acid and sodium hydroxide treatment was investigated. Reducing the ash content increases the surface area of the carbon black particles and expands the range of utilization of the CBp. The soluble and non-soluble salts formed (sulphates and hydroxides, respectively) by mixing the spent sulfuric acid and sodium hydroxide can be used for other applications. Jianfeng Huang, Fei Shen, Xianhui Li, Xuanquan Zhou, Binyao Lia, Renliang Xua, Chifei Wu [6] worked on Chemical modification is the most popular

and efficacious approach to improve dispersion stability for commercial carbon blacks in organic media. Even though this method has been used successfully in liquid systems, there have been few reports of chemical modification of carbon black in nonliquid- phase systems. In the present work, a simple non-liquid-phase approach to preparing modified carbon black with high dispersibility and stability in polar organic media from an industrial carbon black, N220, is reported. The treatment was carried out in a rheology mixer by blending carbon black with a low-molecular-weight organic compound.Tthe chemical modification based on AO-80 fragments grafting onto CB particles was carried out in a solvent-free, non-liquid-phase system. The work demonstrates a feasible approach to CB modification on a large scale.

## 3. OBJECTIVE OF THE PROJECT

Investigation of the Carbon Black obtained from waste tyre after pyrolysis process and the proximate analysis of the Carbon Black.

## 4. TECHNIQUES TO BE USED

1- Pyrolysis of waste tyre

2- Atomic Absorption Spectroscopy

3- Proximate analysis of carbon black

## 5. PYROLYSIS PROCESS

Pyrolysis is a thermochemical process in which organic compounds are decomposed at higher temperature. Pyrolysis consists of two word ; ”pyro” means fire and “lysis” means breakdown. Mainly pyrolysis includes breakdown of organic matter into simplest products in the absence of oxygen. However it not possible to get oxygen free atmosphere commercially. When pyrolysis takes place in presence of water it is known as hydro-pyrolysis. This process is enormously used in chemical industries. Coke is the pyrolysis product of coal, similarly many other useful products can be obtained from pyrolysis process, such as charcoal, activated carbon are obtained from wood. There are two main factors affect the economy of pyrolysis plant: tipping fees charge for disposal of waste tires and other is selling price of pyrolysis products. Now a day the value of tipping fees for waste disposal is increasing day by day, but the selling price of pyrolysis product is decreasing because of low market value and low calorific value. So in order to earn a profit we have to reprocess the products such as carbon black. Carbon black can be converted into activated carbon, high grade carbon black and valuable chemicals which has high calorific value and can be used as an alternative fuel. Pyrolysis mainly carried out in the range 500-900 $^{0}$C. The main products of the tire pyrolysis process are: Solid char (30-40 wt%), liquid residue (40-60 wt%) and gases (5-20 wt%). The solid residue contains carbon black and the mineral matter initially present in the tire[4]. This solid char can be used as reinforcement in the rubber industry, as activated carbon or as smokeless fuel. The liquid product consists of a very complex mixture of organic components. Thus, the derived oils may be used directly as fuels, petroleum refinery feedstock or a source of chemicals. The gaseous fraction is mainly of non-condensable organics as, $H_2$, $H_2S$, CO, $CO_2$, $CH_4$, $C_2H_4$, $C_3H_6$ etc. The gas fraction can be used as fuel in the pyrolysis process.

### 5.1 Types of Pyrolysis

Pyrolysis is mainly of two types-

(1) Fast pyrolysis

(2) Slow pyrolysis.

Fast pyrolysis is the pyrolysis process in which pyrolysis process takes place within two seconds. It is also known as flash pyrolysis. Here the temperature varies between 300-500$^0$C. In fast pyrolysis char deposition rate is high and needs frequent removal. It can further sub catagorised to (i) Ablative fast pyrolysis- In this process larger particle size biomass is preferred. Pressure is applied to biomass to increase decomposition rate by the use of centrifugal or mechanical force. (ii) Cyclonic fast pyrolysis-otherwise known as vortex fast pyrolysis. It separates solids from non-condensable gases and returns them to mixture. (iii) Rotating cone fast pyrolysis- In this process biomass is mix with hot sand at ambient temperature. It produces 70% condensable gases, 15% non-condensable gases and 15% char. Feed stock for fast pyrolysis can be any organic material.

Slow pyrolysis- As the name suggests here decomposition of organic matter takes a longer period of time. Vaccum pyrolysis is a slow pyrolysis process. Feed stock can be any organic material for this process. Pyrolysis plant mainly consists of oil fuel burner, furnace, pyrolysis reactor, double screw reactor, second heat steam boiler. As shown in figure 2. [3].


Fig. 2 Setup of pyrolysis plant [3]

1, 2 – Both furnaces with oil fuel burners at front 3, 4 – both heating boxes with every of double-screw reactor inside; 5 – heat utilizing steam boilers.

### 5.2 Characteristics and Composition of the Pyrolysis Products

Pyrolysis as a method for recycling of waste tire depends on the market for pyrolysis products. For this, characterization of pyrolysis products and their application in other processes is very important. At present time, the main application for solid char is its use as active carbon, as reinforcement in rubber industry and as smokeless fuel. The liquid product can be used as a fuel or a source of chemicals and the gas fraction as a fuel in the pyrolysis process.

| Components | %age present |
|---|---|
| Pyro-oil | 35-45 |
| Pyro-gas | 25-15 |
| Carbon-black | 35-40 |
| Steel wire | <10 |

**1. Solid Residue**

The solid residue mainly contains carbon black and the mineral component initially present in the tire. These activated carbons have been used to adsorb phenols, dyes, metals, phenols, butane and natural gas. Active carbon from solid product of pyrolysis process is produced by activation with an activating gas at 800-100$^{o}$C. Carbon characteristics (mainly specific area) are greatly influenced by the degree of the activation also by nature of activating agent (steam or $CO_2$) and process temperature. Based on the current technology and literatures results tire charge activation below 700$^{o}$C looks impossible. The particle size of the tire rubber was found to have influence on the porosity of the resultant carbon generated from steam activation. Elemental analysis carried out by Zabaniotou et. al shows that char contains 71 wt.% of C, 13.3% wt. of O, 5.4 wt.% of Fe, 2.8 wt.% of S, 2.3 wt.% of Zn, 1.3 wt.% of Ca, and 0.3 wt.% of Al [4].

2. **Pyrolysis Liquid Product**

The liquid phase is very important product of tire pyrolysis process. There are many papers in the literature devoted to the study of the characteristics of pyrolysis liquid products. Gas chromatography/Mass spectroscopy (GC/MS) is the most common method used not only for examining pyrolysis liquid product, but also for examining the gas yield and products of char combustion. Laresgoiti et al, present a detailed characterization of the all pyrolysis liquids found at 300, 400, 500, 600, and 700$^{o}$C. All the Gas chromatography analysis, elemental analysis, gross calorific values and distillation data were studied. They report that tire derived liquids are a complex mixtures of $C_6$-$C_{24}$ organic compounds containing a lot of aromatics (53.4–74.8%),

some nitrogenated (2.47–3.5%) and some oxygenated compounds (2.29–4.85%). Their gross calorific value (42 MJ kg−1) is even greater than that specified for commercial heating oils, but the sulphur content (1–1.4%) is nearby or slightly over the limit value. Significant amount of valued light hydrocarbons such as toluene, benzene, xylene, etc. were obtained. The concentration of these compounds rises with temperature up to 500°C and then declines. There is also vital portion of polycyclic aromatics, like phenanthrenes, naphthalenes, fluorenes, diphenlys, etc.; their concentration as well as that of total aromatics rise significantly with temperature. Pakdel et. al. reports that vacuum pyrolysis of used tires produces approximately 55 wt.% of pyrolysis oil. This oil typically comprises 20-25 wt.% of naphtha fraction with a boiling point lesser than 200$^{o}$C. The naphtha fraction generally contains 20-25 wt. % *dl*- limonene. Williams and Taylor, found that pyrolytic oil had molecular weight range from 50 to 1200.

3**. Pyrolysis Gases**

The gas fraction obtained in different experimental systems indicates significant variations. For example: Berrueco et. al. obtained the gas yield 2.4-4.4 wt.%, but Chang 30-53 wt.%. Laresgoiti et al., using an autoclave in a nitrogen atmosphere at temperatures between 400 and 700 C, found that the pyrolyzed gases consisted of CO, $CO_2$, $H_2S$ and hydrocarbons such as $CH_4$, $C_2H_4$, $C_3H_6$ and $C_4H_8$, and their unsaturated derivatives. Berrueco et. al. analysing pyrolysis gases by gas chromatography, found that the main gases produced by the pyrolysis process are $H_2$, CO, $CO_2$ and hydrocarbons: $CH_4$, $C_2H_4$, $C_3H_6$ and $C_4H_8$. Roy et al.obtained gases by vacuum pyrolysis, mainly composed of $H_2$, CO, $CO_2$ and a few hydrocarbon gases. In general, main components of A complex study of process conditions such as temperature, $O_2$ concentration and particle sizes on combustion behaviour and pollutant emissions was not found in the literature. For disposal of waste tires by combustion with minimum environmental impact also for the prevention of fire hazards in tire landfills, more research in this area is required.

## 5.3 Types of Reactor

Reactors used in pyrolysis are classified depending how the solids move in them.

They are categorized into four types.

1. Type A-No solid movement through reactor.
2. Type B-Moving bed (shaft furnaces)
3. Type C- Movement caused by mechanical forces (Rotary kiln, rotating screw etc.)
4. Type D-Movement caused by fluid flow (Fluidized bed, spouted bed, entertain bed etc.)

# 6. ATOMIC ABSORPTION SPECTROSCOPY

It is a spectroanalytical method for determination various chemical constituent of substance by absorbing radiation by free atoms in gaseous state. Atomic spectroscopy is the method for determining the elemental composition of an analyte by its electromagnetic or mass spectrum.
Many analytical techniques are available and selecting the most suitable one is the key to achieving exact, reliable, real-world results. Proper choice requires a basic understanding of each method since each has its individual limitations and strengths. It also involves a clear thoughtful of laboratory's analytical requirements.

## 6.1 Types of AAS

There are three broadly accepted analytical methods – atomic absorption, atomic emission and mass spectrometry – which will form the focus of our discussion, allowing us to go into greater depth on the most common methods in use today:

- Flame Atomic Absorption Spectroscopy
- Graphite Furnace Atomic Absorption Spectroscopy
- Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES)
- Inductively Coupled Plasma Mass Spectrometry (ICP-MS)

## 6.2 Flame Atomic Absorption Spectroscopy

Atomic Absorption (AA) follows when a ground state atom absorbs energy in the form of light of a specific wavelength and is raised to an excited state. The amount of light energy absorbed at this wavelength will increase as the number of atoms of the selected element in the light path increases. The connection between the amount of light absorbed and the concentration of analytes present in known standards can be used to determine unidentified sample concentrations by determining the quantity of light they absorb. Carrying out atomic absorption spectroscopy requires a prime light source, an atom source, a monochromator to separate the specific wavelength of light to be measured. A detector is used to measure the light correctly, electronics to process the data signal and a data display to show the results. The light source usually used is a hollow cathode lamp (HCL) or an electrodeless discharge lamp (EDL). Overall, a different

lamp is used for every one element to be determined, although in some cases, a few elements can be collective in a multi-element lamp. Previously, photomultiplier tubes have been used as detector. At present, in most modern instruments, solid-state detectors are now used. Flow Injection Mercury Systems (FIMS) are specialized, easy-to-perform atomic absorption spectrometers for the determination of mercury. These instruments use a high-performance single-beam optical system with a low-pressure mercury lamp and solar-blind detector for supreme performance. Whatever the system, the atom source used must produce free analyte atoms from the sample. The source of dynamism for free-atom production is heat, usually in the form of an air/acetylene flame. The sample is familiarized as an aerosol into the flame by the sampleintroduction system containing a nebulizer and spray chamber. The burner head is bring into line so that light beam passes through the flame, where the light is absorbed.

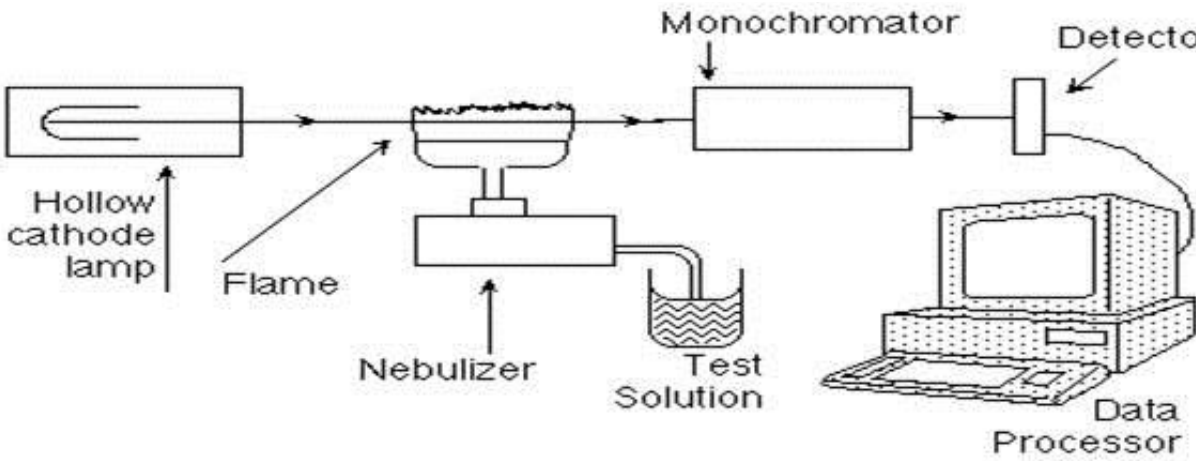


Figure.3-Flame Atomic Absorption Spectroscopy set up

The main limitation of Flame AA is that the burner-nebulizer system is comparatively inefficient sampling device. Only a less fraction of the sample reaches the flame and the atomized sample passes swiftly through the light path. An improved sampling device would atomize the whole sample and recollect the atomized sample in the light path for a long period of time, enhancing the warmth of the technique, which leads us to the next method – electro thermal vaporization using a graphite furnace.

### 6.3 Graphite Furnace Atomic Absorption Spectroscopy

In Graphite Furnace Atomic Absorption (GFAA), the sample is bring together directly into a graphite tube, which then is heated in a planned series of steps to eliminate the solvent and major matrix components and to atomize the left over sample. All the analyte is atomized, and the atoms are recollected within the tube (and the light path, which passes through the tube) for an long period of time. As a result, sensitivity and recognition limits are significantly improved over Flame AA. Graphite Furnace analysis times are longer than for Flame sampling, and fewer elements can be detected using GFAA.

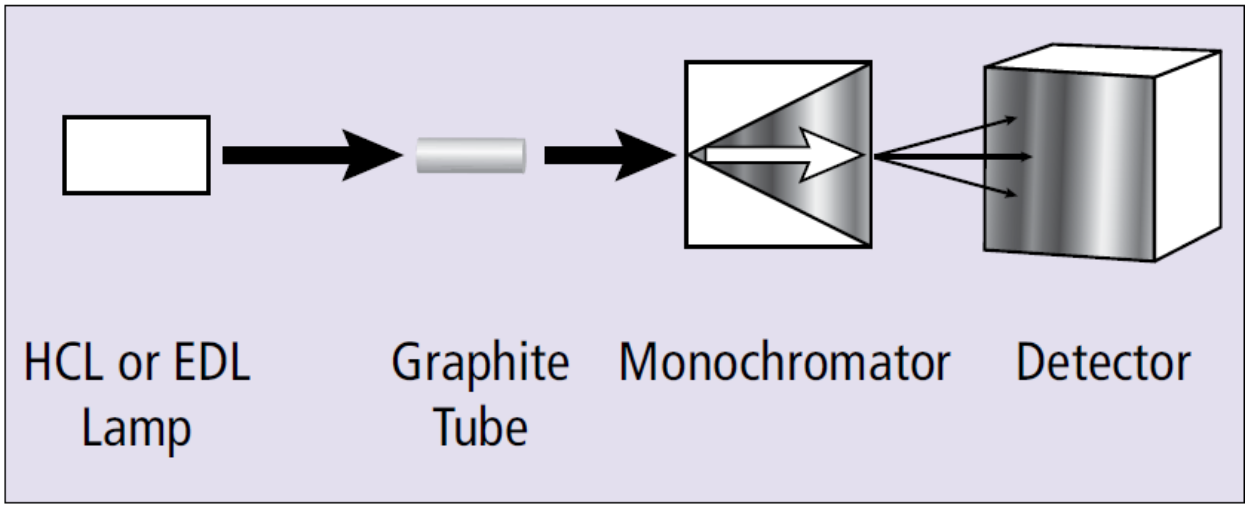


**Fig. 4- Graphite Furnace Atomic Absorption Spectroscopy set up**

However, the improved sensitivity of GFAA and its facility to analyze very small samples, significantly swells the capabilities of atomic absorption. GFAA allows the detection over 40 elements in microliter sample volumes with detection limits typically 100 to 1000 times better than those of Flame AA systems.

### 6.4 Inductively Coupled Plasma Optical Emission Spectroscopy

ICP is an argon plasma sustained by the interaction of an RF field and ionized argon gas. The plasma can extent temperatures as high as 10,000 ˚K, allowing the complete atomization of the

elements in a sample and minimizing potential chemical interferences. Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) is the measurement of the light emitted by the elements in a sample introduced into an ICP source. The measured emission intensities are then compared to the intensities of standards of known concentration to obtain the elemental concentrations in the unknown sample.

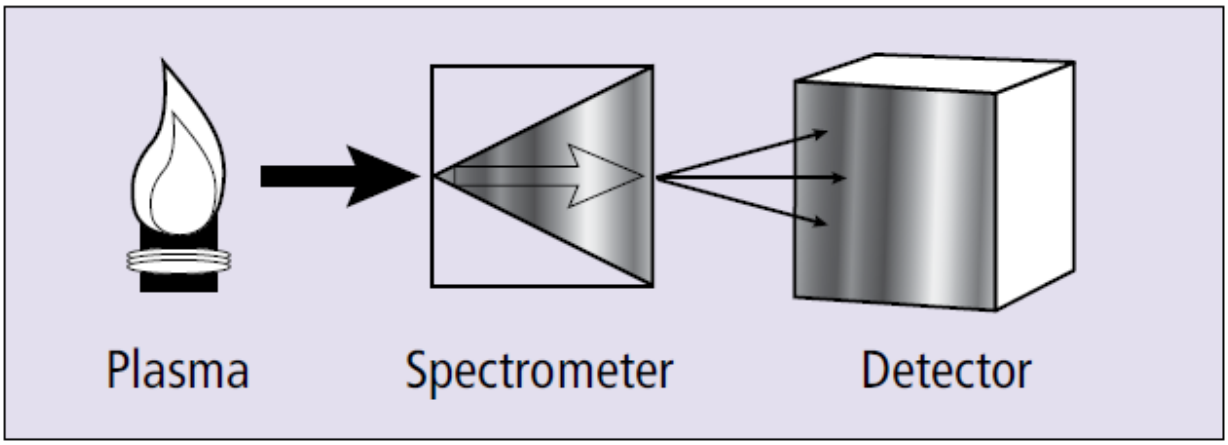


**Fig.5 Simplified drawing of basic ICP system**

There are mainly two ways of viewing the light emitted from an ICP. In classical ICP-OES configuration, the light through the plasma is viewed radially, resulting in the uppermost linear ranges. By viewing the light radiated by the sample looking down the center of the torch or axially, the continuum background from the ICP itself is reduced and sample path is maximized. Axial viewing provides better detection limits than those obtained via radial viewing by as much as a factor of 10. The most actual systems allow the plasma to be viewed in both orientation in a single analysis, providing the best detection capabilities and widest working ranges.

The optical system used in ICP-OES consists of spectrometer which is used to distinct the individual wavelengths of light and focus the required wavelengths onto the detector. Older, “direct reader” types of ICP-OES systems are used a series of photomultiplier tubes to define pre-selected wavelengths. The limited the number of elements that could be detected as the wavelengths were generally stable once the instrument was manufactured. Sequential-type systems can select any wavelength and focus it on a single detector. However, this is done one element at a time, which can lead to longer analysis times. In today’s modern ICP-OES systems,

solid-state detectors based on charge-coupled devices (CCD) are used, providing very flexible systems and eliminating the need for large numbers of single photomultiplier detectors.

### 6.5 Inductively Coupled Plasma Mass Spectrometry

With Inductively Coupled Plasma Mass Spectrometry (ICP-MS), the argon ICP generates singly charged ions from the elemental species within a sample that are directed into a mass spectrometer and separated according to their mass-to-charge ratio. Ions of the selected mass-to-charge ratio are then directed to a detector that determines the number of ions present. Typically, a quadrupole mass spectrometer is used for its easeof- use, robustness and speed. Due to the similarity of the sample-introduction and data-handling techniques, using an ICP-MS is very much like using an ICP-OES system. ICP-MS combines the multi-element capabilities of ICP techniques with exceptional detection limits equivalent to or below those of GFAA. It is also one of the few analytical techniques that allows the quantification of elemental isotopic concentrations and ratios, as well as precise speciation capabilities when used in conjunction with HPLC or GC interfaces. This feature enables the analytical chemist to determine the exact form of a species present – not just the total concentration. However, due to the fact that the sample components are actually introduced into the instrument, there are some limitations as to how much sample matrix can be introduced into the ICP-MS.

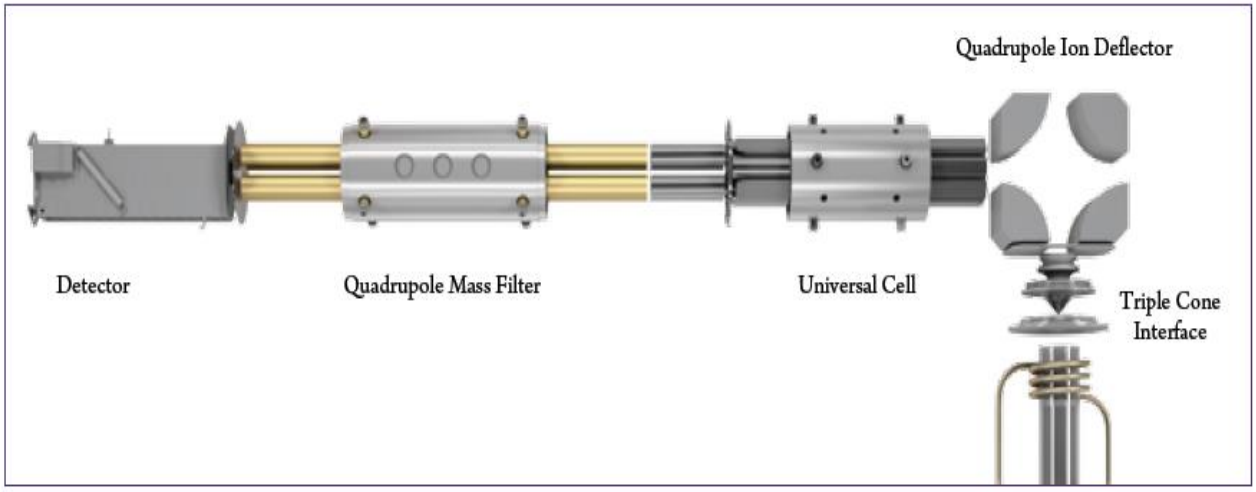


**Fig.6 Simplified drawing of ICP-MS system with Universal Cell Technology (UCT).**

In addition, there are also increased maintenance requirements as compared to ICP-OES systems. Generally, ICP-MS systems require that the total dissolved solids content of a sample be below 0.2% for routine operation and maximum stability. There are several items, such as the interface cones and ion lens, located between the ICP torch and the mass spectrometer, that need to be cleaned on a periodic basis to maintain acceptable instrument performance. Recent developments have led to new technologies to increase the robustness and stability of ICP-MS. Orthogonal ion lens systems increase the ability of the ICP-MS to handle higher total dissolved solids content and dramatically improve longterm stability for high matrix solutions. Interference control has been made even easier by using universal cell technologies that include both collision (using Kinetic Energy Discrimination KED) and Dynamic Reaction Cell (DRC) in a single instrument allowing the analyst to choose the best technique for their samples.

## 7. PROXIMATE ANALYSIS OF THE CARBON BLACK

Proximate analysis has been used to determine the rank of carbon black by separating its various components such as volatile components, fixed carbon and inert components etc. Because of the wide ranging value of carbon black products and their commercial value of ranking these products the need for good methods is necessary. Proximate analysis gives us information regarding the composition of carbon black.

It mainly consists is following

(i) Moisture content

(ii)Volatile matter content

(iii)Ash content

(iv) Fixed carbon content

**Moisture content**

Moisture content is determined by the loss in weight that happens when a sample is dried to a constant weight in oven. Around 2g of a feed sample is weighed into a silica dish earlier dried and weighed. This sample is then dried in oven at $650^0$C for 36 hours, cooled in a desiccator and weighted. The drying and weighing lasts until a constant weight is attained.

$$\%\text{Moisture} = \frac{(\text{wt. of sample + dish before drying}) - (\text{wt. of sample + dish after drying})}{\text{Wt. of sample taken}} \times 100$$

As the water content of feed varied widely, ingredients and feed are typically compared for their nutrient content on moisture free or dry matter (DM) basis. %DM = 100 - %Moisture.

**Ash content**

Ash is the inorganic residue obtained by burning off the organic matter of feed stuff at 400-$600^0$C in muffle furnace for 4 hours. 2g of sample is weighed into pre-heated crucible. The crucible is placed into muffle furnace at 400-$600^0$C for 4 hours or until whitish-grey ash is procured. The crucible is then positioned in the desiccator and weighed. %Ash =( wt. of crucible + ash – wt. of crucible) ÷ wt. of sample

## 8. RESULT AND DISCUSSION

Analysis the Carbon black by Atomic Absorption Spectroscopy in the institute laboratory. After the analysis I found to some metal in percentage form from pyrolysis CB which given below in Table 2 and proximate analysis given in Table 3.

**Table 2**

| Name of Metal | Quantity Present(in mg/lit) |
|---|---|
| Nickel | 0.062 |
| Lead | 0.088 |
| Zinc | 0.009 |

**Table 3**

| Components | % |
|---|---|
| Moisture | 1.66 |
| Volatile matter | 3.14 |
| Ash | 6.65 |
| Fixed carbon | 86.55 |

## CONCLUSION

From the above study about Carbon black, it is very much clear that carbon black has a very wide range of application. Various products obtained from pyrolysis of waste tyre such as carbon black, pyro oil, pyro gas, steel wire etc. can be very useful in future. Pyro oil and pyro gas can be used as secondary fuel source. Steel wire obtained can be reused in steel industry. Now days more focus is on carbon black, because of its high calorific value. From proximate analysis of carbon black it was found that percentage of carbon is 86.55 which are high. Hence it can have greater calorific value and can be used as alternative fuel. The presence of metals such as Nickel, Zinc, Lead were found in traces. After removing these metals from carbon black it can be converted to activated carbon. Activated carbon has a higher market value. This carbon black reduces the amount of pollutants. All most all over the world waste tyres are wasted, by the application of tyre pyrolysis process it can helpful.

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